Seagate

Invention disclosure

Recording Head Operations

STRUCTURES TO AHICVE HIGH SENSTIVITY IN TUNNELING GMR HEADS USING RU ANTIPARALELL MAGNETIC ALIGMENTS

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Introduction

For ultra high recording head application the track density (TPI) increases more the 100% a year. Now the physical line width is reaching 0.1 um for 150 KTPI track density or 100G heads. For 200G head the track width will be only 0.05 um or 50 nm. The linear bit density is also close to 700 KBPI. The shield-to-shield spacing is down to 60 nm. The reader needs to provide sufficient signal (amplitude) for the system performance. Tunneling GMR heads seems to be the only device which can meet the requirement. In this invention a new way to make a TGMR head is proposed. The free layer is composed with a synthetic magnetic layer which improves the free layer dynamic range thus the head sensitivity.

Description of the Invention

Fig. 1 the conventional TGMR head structure as shown in the prior art. Fig.2 is the new approach for the reader structure. Fig. 3 is another embodiment of the SAF free layer TGMR heads. In the reading element the free layer self demag field will stiffen the free layer itself when the free layer is excited under the media field. The stiffness or the self demag field is proportional to the free layer magnetic moments. The use of SAF free layer will results in a smaller net magnetic moments due tot he anti-parallel alignment in the SAF structure. The feasibility of such a SAF free layer in conventional spin valve is limited because of the shunting effect and reduction of the GMR effect. However, in TGMR heads the current is perpendicular to the films plane and addition of the metallic layers will not cause any shunting effect. No reduction of TGMR ratio is observed when an extra layer is added. Modeling work indicates that the sensitivity can be 50 to 100% higher.

1. SAF structure is used in a TGMR head.
2. The SAF free layer can be stabilized by convention PM layer
3. An AFM stabilization layer can be used for the free layer stabilization.
4. SAF free layer has more total magnetic moments which help the magnetic fluctuation due to the thermal excitation.
5. SAF free layer also has less net magnetic moments which increase the sensitivity.
6. The closure magnetic structure near the edges helps the stability as well.
7. The pinned layer can be also released for signal sensing to improve the sensitivity. Such a layer can also be of SAF structure.

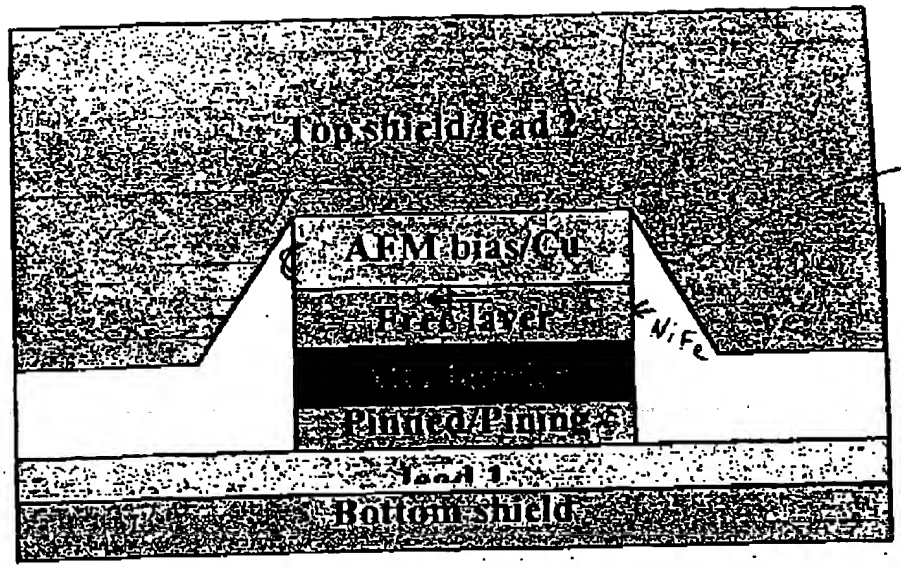

Fig. 1 Standard TGMR head with a simple free layer biased by an AFM

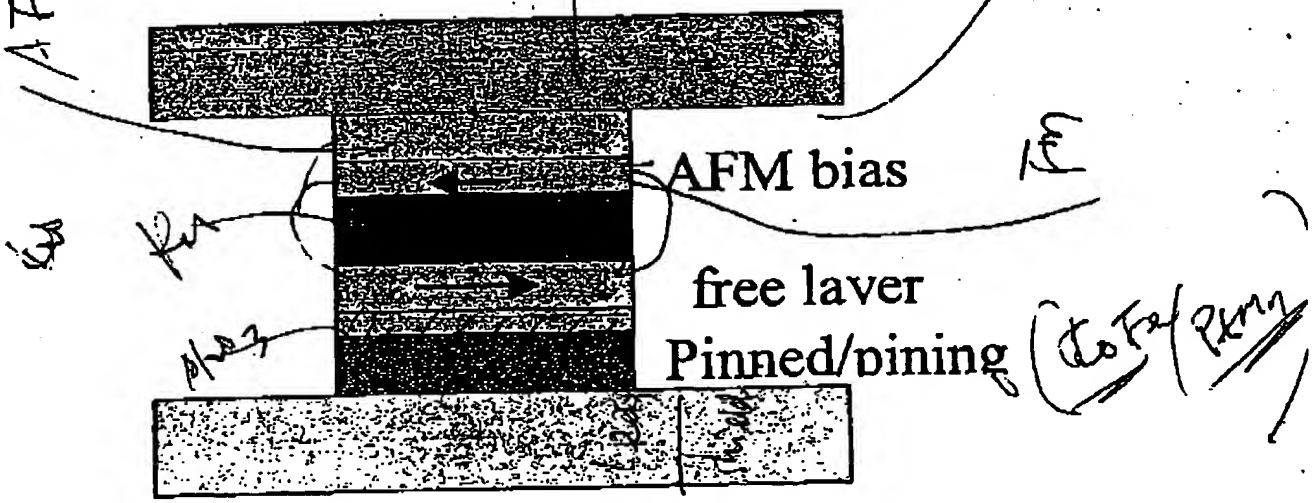

Fig. 2 New structure where the AFM bias layer is coupled with another magnetic layer directly tot he AFM. Free layer is coupled through the Ru spacer which provide antiferromagnetic interaction